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(54) AQUEOUS INK COMPOSITION CONTAINING ANTI-CURL AGENT

(57)Abstract:

PURPOSE: To obtain an aqueous ink composition which reduces or removes paper curls in plainpaper printed elements at a low cost without adversely

affecting the storage stability, decap property or the print quality which comprises an aqueous carrier medium, a colorant and an anti-curl agent.

CONSTITUTION: This composition contains (A) an aqueous carrier medium (preferably a mixture of a water-soluble organic solvent having at least two hydroxide groups such as diethylene glycol or the like and water) (B) a colorant (preferably a pigment dispersion or a dye) and (C) an anti-curl agent (preferably 1,3-diols or the like of 2,2-dimethyl-1,3-propanediol or the like). The amount of component C blended is preferably from 15 to 30 (wt.%) against the total weight of the ink. When an organic pigment is used as component B, components A and B are preferably blended at ratios of from 84 to 99.8% and from 0.1 to 8% respectively against the total amount of the ink and when a dye is used from 80 to 99.8% and from 0.1 to 50% respectively.

CLAIMS

[Claim(s)]

[Claim 1] (a) An aqueous carrier medium;

(b) Colorant; and (c) An aqueous ink composition containing at least one curl inhibitor of sufficient quantity to remove curl in a regular paper printing element substantially.

[Claim 2] A curl inhibitor has at least 4.5% of water solubility at 25 °C and it is (a). 1,3-diol, 1,3,5-triol, amino-1,3-diol and the following structural formula : [Formula 1]

[Independently R^1, R_2, R_4, R_5 and R_6 among a formula H are C_nH_{2n+1} (it is $n=1-4$ here) or $C_nH_{2n}O(CH_2CH_2O)_bH$ (it is $n=1-6$ and $b=0-25$ here) and; $R_3=HC_nH_{2n+1}$ (it is $n=1-4$ here) $C_nH_{2n}O(CH_2CH_2O)_bH$ (it is $n=1-6$ and $b=0-25$ here) or $(CH_2)_eNXZ$ (here -- X and Z -- independently -- H -- it CH_3 (ing) and) Are C_2H_5 or $C_2H_4O(CH_2CH_2O)_dH$ (it is $d=0-25$ and $e=0-3$ here) and; $Y=H$ or CH_3 ; a and c independently. The polyoxyalkylene derivative which has that it is 0-25 and the

totals of; and a CH₂CHYO unit are 0-100];

(b) Polyols and the following structural formula : [Formula 2]

[Among a formula independently R is HC_nH_{2n+1} (it is n= 0-4 here) or CH₂O(CH₂CHYO)_eH and; Y=HCH₃; b=0 or 1; a Although c and e are 0-40 independently and the totals of; f=1-6; and a CH₂CHYO unit are 0-100 The polyoxyalkylene derivative which has that however e is not 0 when it is abcd= 0 and f= 1 and R is not H but acd= 0 and f= 1];

(c) The following structural formula : [Formula 3]

[The inside of a formula X=HOHCH₂O(CH₂CHYO)_aH It is O(CH₂CHYO)_bH or OM (OM is a metallic cation here) and is : n=2 - 7; R=(CH₂CHYO)_c (here). Compound which has that Y=H or CH₃; a and c are 0-25 independently and the totals of; and a CH₂CHYO unit are 0-125];

(d) Pyranoside and the following structural formula : [Formula 4]

The polyalkoxy alkylene derivative which has [it is inside of a formula R=H or C_nH_{2n+1} (it is n= 0-4 here) and; a, b, c and d are 0-30 independently and the totals of; Y=H or CH₃; and a CH₂CHYO unit are 0-120];

(e) Structural formula: H-(OCH₂CHY)_xOH (inside of formula Y=H or CH₃ and x= 3-20); and the (f) structural formula which are the following : Z₁Z₂N(CH₂CH₂NZ₃)_nZ₄ The inside of [type Z₁Z₂Z₃ and Z₄ are a H (here) independently (CH₂CHYO). The ink composition according to claim 1 chosen from the group which consists of a polyoxyalkylene derivative of the aliphatic polyamine which has that it is Y=H or CH₃; n=1-20; a is 0-20 independently and the totals of; and a CH₂CHYO unit are 3-200].

[Claim 3] The ink composition according to claim 2 which is a pigment dispersion

object object in which colorant contains paints and a polymers dispersing agent.

[Claim 4]The ink composition according to claim 2 whose colorant is a color.

[Claim 5]The ink composition according to claim 2 which is a compound in which a curl inhibitor has a structural formula (a).

[Claim 6]The ink composition according to claim 5 chosen from a group which R_3 and R_4 become from H and C_nH_{2n+1} (hereit is $n= 1-4$) independently.

[Claim 7]The ink composition according to claim 5 whose curl inhibitor is 2,2-dimethyl- 1,3-propanediol.

[Claim 8]The ink composition according to claim 5 whose R_3 is NXZ (hereX is chosen from a group which consists of $HCH_3C_2H_5$ and $C_2H_4 OH$).

[Claim 9]The ink composition according to claim 5 which is total =2-50 of a CH_2CHYO unit.

[Claim 10]The ink composition according to claim 5 whose curl inhibitors are the 3-methyl- 1 and 3 and 5-pentanetriol.

[Claim 11]The ink composition according to claim 2 which is a compound in which a curl inhibitor has a structural formula (b).

[Claim 12]The ink composition according to claim 11 which is total =3-50 of a CH_2CHYO unit.

[Claim 13]The ink composition according to claim 11 whose curl inhibitor is a 2-ethyl-2-(hydroxymethyl)-1,3-propanediol.

[Claim 14]The ink composition according to claim 11 whose curl inhibitor is a 2-methyl-2-(hydroxymethyl)-1,3-propanediol.

[Claim 15]The ink composition according to claim 11 whose curl inhibitor is sorbitol.

[Claim 16]The ink composition according to claim 2 which is a compound in which a curl inhibitor has a structural formula (c).

[Claim 17]The ink composition according to claim 16 whose curl inhibitor is alpha D-glucose.

[Claim 18]The ink composition according to claim 2 which is a compound in which a curl inhibitor has a structural formula (d).

[Claim 19]The ink composition according to claim 18 whose curl inhibitor is an oxyalkylene derivative of methyl alpha D-glucoside.

[Claim 20]The ink composition according to claim 2 which is a compound in which a curl inhibitor has a structural formula (e).

[Claim 21]The ink composition according to claim 20 chosen from a group which a curl inhibitor becomes from triethylene glycol which has a molecular weight of the range of 200-400tetraethylene glycoland a polyethylene glycol.

[Claim 22]The ink composition according to claim 2 which is a compound in which a curl inhibitor has a structural formula (f).

[Claim 23]The ink composition according to claim 22 whose curl inhibitor is a polyoxyethylene derivative of ethylenediamine.

[Claim 24]An ink composition which the above-mentioned polymers dispersing agent is the ink composition according to claim 3 containing block copolymerand makes it together with weight of about 0.1 to 8% of paints0.1 to 8% of block copolymerand a curl inhibitor on the basis of gross weight of an ink compositionand contains 84 to 99.8% of aqueous carrier medium.

[Claim 25]The ink composition according to claim 4 which makes it together with weight of about 0.01 to 20% of colorand a curl inhibitor on the basis of gross weight of an ink compositionand contains 80 to 99.99% of aqueous carrier medium.

[Claim 26]The ink composition according to claim 4 which contains further polymer chosen from a group which consists of AB block polymerBAB block polymerABC block polymerand random polymer.

[Claim 27]an ink jet printer which has the color gamut by which the above-mentioned ink was improved -- service water -- the ink composition according to claim 4 in which it is some sex color system ink setsand the above-mentioned ink contains a curl inhibitor including cyan inkmagenta inkand yellow inkrespectively in the above-mentioned ink set.

[Claim 28]Cyan ink contains 1.75 to 2.5% of acid blue 9 colorThe ink composition according to claim 27 in which yellow ink contains 1.75 to 3% of acid yellow 23

colorant magenta ink contains 1 to 3% of reactive reactivity red 180 colorant 0.3 to 1.5% of acid red 52 color.

[Claim 29]The ink composition according to claim 1 in which a curl inhibitor exists in 10 to 75% of the weight of quantity on the basis of gross weight of ink.

[Claim 30]The ink composition containing jet ink in which the above-mentioned ink composition has the viscosity of 20 or less cp at surface tension of about 18 to 70 dyne/cm and 20 ** according to claim 1.

[Claim 31]The ink composition according to claim 1 which furthermore contains a surface-active agent.

[Claim 32]It is a reducing method of curl of paper of a regular paper print element which consists of a process of usually giving an ink composition intrinsically to a base paperA method containing at least one curl inhibitor of sufficient quantity for the above-mentioned ink composition to remove substantially curl of an aqueous carrier medium colorant and the above-mentioned common base paper.

[Claim 33]A curl inhibitor has at least 4.5% of water solubility at 25 ** and it is (a). 1,3-diol, 1,3,5-triolamino-1,3-diol and the following structural formula : [Formula 5]

[Independently R^1, R_2, R_4, R_5 and R_6 among a formula H are C_nH_{2n+1} (it is $n=1-4$ here) or $C_nH_{2n}O(CH_2CHYO)_bH$ (it is $n=1-6$ and $b=0-25$ here) and; $R_3=HC_nH_{2n+1}$ (it is $n=1-4$ here) $C_nH_{2n}O(CH_2CHYO)_bH$ (it is $n=1-6$ and $b=0-25$ here) or $(CH_2)_eNXZ$ (here -- X and Z -- independently -- H -- it CH_3 (ing) and) Are C_2H_5 or $C_2H_4O(CH_2CHYO)_dH$ (it is $d=0-25$ and $e=0-3$ here) and; $Y=H$ or CH_3 ; a and c independently. The polyoxyalkylene derivative which has that it is 0-25 and totals of; and a CH_2CHYO unit are 0-100];

(b) Polyols and the following structural formula : [Formula 6]

[Among a formula independently R is HC_nH_{2n+1} (it is $n=0-4$ here) or $CH_2O(CH_2CHYO)_eH$ and; $Y=H$ or CH_3 ; $b=0$ or 1; a Although c and e are 0-40

independently and the totals of; $f=1-6$; and a CH_2CHYO unit are 0-100. The polyoxyalkylene derivative which has that however is not 0 when it is $abcd=0$ and $f=1$ and R is not H but $acd=0$ and $f=1$;

(c) The following structural formula : [Formula 7]

[The inside of a formula $X=\text{HOHCH}_2\text{O}(\text{CH}_2\text{CHYO})_a\text{H}$ it is $\text{O}(\text{CH}_2\text{CHYO})_b\text{H}$ or OM (OM is a metallic cation here) and is : $n=2-7$; $R=(\text{CH}_2\text{CHYO})_c$ (here). Compound which has that $Y=\text{H}$ or CH_3 ; a and c are 0-25 independently and the totals of; and a CH_2CHYO unit are 0-125];

(d) Pyranoside and the following structural formula : [Formula 8]

The polyalkoxy alkylene derivative which has [it is inside of a formula $R=\text{H}$ or $\text{C}_n\text{H}_{2n+1}$ (it is $n=0-4$ here) and; a , b , c and d are 0-30 independently and the totals of; $Y=\text{H}$ or CH_3 ; and a CH_2CHYO unit are 0-120];

(e) Structural-formula: $\text{H}-(\text{OCH}_2\text{CHY})_x\text{OH}$ (inside of formula $Y=\text{H}$ or CH_3 and $x=3-20$); and the (f) structural formula which are the following : $\text{Z}_1\text{Z}_2\text{N}(\text{CH}_2\text{CH}_2\text{NZ}_3)_n\text{Z}_4$. The inside of [type $\text{Z}_1\text{Z}_2\text{Z}_3$ and Z_4 are $a\text{H}$ (here) independently (CH_2CHYO). The method according to claim 32 chosen from the group which consists of a polyoxyalkylene derivative of the aliphatic polyamine which has that it is $Y=\text{H}$ or CH_3 ; $n=1-20$; a is 0-20 independently and the totals of; and a CH_2CHYO unit are 3-200].

[Claim 34] A way according to claim 33 a curl inhibitor is a compound which has a structural formula (a).

[Claim 35] A way according to claim 33 a curl inhibitor is a compound which has a structural formula (b).

[Claim 36] A way according to claim 33 a curl inhibitor is a compound which has a structural formula (c).

[Claim 37] A way according to claim 33 a curl inhibitor is a compound which has a

structural formula (d).

[Claim 38]A way according to claim 33 a curl inhibitor is a compound which has a structural formula (e).

[Claim 39]A way according to claim 33 a curl inhibitor is a compound which has a structural formula (f).

[Claim 40]A way according to claim 33 the above-mentioned colorant contains paints and a polymers dispersing agent.

[Claim 41]A way according to claim 33 the above-mentioned colorant contains a color.

[Claim 42]A way according to claim 41 the above-mentioned ink composition contains AB block polymerBAB block polymerABC block polymerand random polymer further.

[Claim 43]A method according to claim 33 including that the above-mentioned process of the above-mentioned ink composition containing ink jet inkand giving the above-mentioned ink to a base material gives the above-mentioned ink using an ink jet printer.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to a water-based ink and the aquosity ink jet composition from which curl of the printed regular paper element is removed more in details.

[0002]

[Background of the Invention]Ink jet printing is the non-shock nature method which produces the ink droplet to which it adheres on paper or a base material like a bright film in response to an electronic digital signal. Heat or a bubble jet type drops ink jet printer on demand (drop-on-demand) is widely used as an

output for personal computers of an office and a home. The water-based ink used for ink jet printing has water as the main ingredients. To the non-aqueous ink in which most comprises an organic solvent water is nontoxic is a non-inflammability and has the advantage of not being harmful to environment. Water is also the outstanding medium for distributed paints or dissolution colors again. [0003] However condensing and using a lot of water is accompanied by some disadvantages. Compared with a low-boiling point organic solvent a vapor rate is slow and this reduces a drying rate therefore water reduces printing speed. Water interacts with paper further and causes two main distortion known as the wrinkles of paper and curl of paper. The wrinkles of paper are distortion which produces a shock a hollow and other non-** at random on printing paper and makes wrinkles in the appearance of paper. Curl is a phenomenon which the edge of paper moves toward the center of paper. The direction of curl may be a side which is a side on which paper was printed or is not printed (the latter is known as "reverse curl"). [0004] One day or two days may be taken for curl to appear immediately after a print or to appear. In the final state a paper sheet takes the gestalt of a pipe. The paper which curled cannot be accumulated or cannot be opened on a sheet therefore a user causes extraordinary inconvenience. The sheet which curled cannot be used for the process which takes ***** like [it is difficult and] medium supply tracking and print consistency to extending or saving. Curl is the most common on a solid restoration print (solid fill printing) therefore is the most serious problem in a chart as what is contrasted with the print of this chapter. For the same reason it is mainly the concerns in 4 color print with a remarkable chart. If a heating element (used since the drying rate of a water-based ink is generally gathered) is used being urged to curl of paper is publicly known.

[0005] Various mechanical contrivance for reducing curl like a heat roller and a tension applicator has been tried. These devices are only effective in a peripheral area and increase the cost and the size of a printer considerably (the heat roller used in order to reduce curl differs from the heater used since a drying rate is gathered.). In the case of the former heat roller heat is applied to the both sides of

paper after a print but when it is the latter heat is applied into a print process.

[0006] It is also publicly known by reforming a print medium to reduce curl. However since consumers like overwhelmingly the printer which can use what cost starts and is sold to the wide range office paper especially the electro photography copying machine paper commercial scene or a what is called "regular paper" printer this approach is not dramatically desirable. Therefore the aqueous ink composition which can be printed on all the page charts is required for this industry without producing paper curl therefore it is less necessary for the inefficient and troublesome mechanical contrivance or the special print medium which cost requires.

[0007] The above-mentioned necessity is satisfied more by low cost rather than obtained by correcting equipment and a medium without being accompanied by any harmful operations like induction of the ink composition (kagation) of this invention i.e. a Kagation low printing quality or preservation instability.

[0008]

[Summary of the Invention] In a certain mode this invention provides the aqueous ink composition containing at least one curl inhibitor of sufficient quantity to remove substantially curl of an aqueous carrier medium colorant and a regular paper printing element. Colorant is a pigment dispersion object or a color. a curl inhibitor has at least 4.5% of water solubility (4.5 g per 100 g of water) at 25 °C -- desirable -- : [0009] (a) 1,3-diol-1,3,5-trisubstituted-1,3-diol and the following structural formula : [Formula 9]

[Independently R^1, R_2, R_4, R_5 and R_6 among a formula H are C_nH_{2n+1} (it is $n=1-4$ here) or $C_nH_{2n}O(CH_2CH_2O)_bH$ (it is $n=1-6$ and $b=0-25$ here) and; $R_3=HC_nH_{2n+1}$ (it is $n=1-4$ here) $C_nH_{2n}O(CH_2CH_2O)_bH$ (it is $n=1-6$ and $b=0-25$ here) or $(CH_2)_eNXZ$ (here -- X and Z -- independently -- H -- it CH_3 (ing) and) Are C_2H_5 or $C_2H_4O(CH_2CH_2O)_dH$ (it is $d=0-25$ and $e=0-3$ here) and; $Y=H$ or CH_3 ; a and c

independently. The polyoxyalkylene derivative which has that it is 0-25 and the totals of; and a CH₂CHYO unit are 0-100];

[0010](b) Polyols and the following structural formula : [Formula 10]

[Among a formula independently R is HC_nH_{2n+1} (it is n= 0-4 here) or CH₂O(CH₂CHYO)_eH and; Y=HCH₃; b=0 or 1; a Although c and e are 0-40 independently and the totals of; f=1-6; and a CH₂CHYO unit are 0-100 The polyoxyalkylene derivative which has that however e is not 0 when it is abcd= 0 and f= 1 and R is not H but acd= 0 and f= 1];

[0011](c) The following structural formula : [Formula 11]

[The inside of a formula X=HOHCH₂O(CH₂CHYO)_aH It is O(CH₂CHYO)_bH or OM (OM is a metallic cation here) and is : n=2 - 7; R=(CH₂CHYO)_c (here). Compound which has that Y=H or CH₃; a and c are 0-25 independently and the totals of; and a CH₂CHYO unit are 0-125];

[0012](d) Pyranoside and the following structural formula : [Formula 12]

The polyalkoxy alkylene derivative which has [it is inside of a formula R=H or C_nH_{2n+1} (it is n= 0-4 here) and; a, b, c and d are 0-30 independently and the totals of; Y=H or CH₃; and a CH₂CHYO unit are 0-120];

[0013](e) Structural-formula: H-(OCH₂CHY)_xOH (inside of formula Y=H or CH₃ and x= 3-20); and the (f) structural formula which are the following :

Z₁Z₂N(CH₂CH₂NZ₃)_nZ₄ The inside of [type Z₁Z₂Z₃ and Z₄ are a H (here) independently (CH₂CHYO). It is chosen from the group which consists of a polyoxyalkylene derivative of the aliphatic polyamine which has that it is Y=H or CH₃; n=1-20; a is 0-20 independently and the totals of; and a CH₂CHYO unit are 3-200].

[0014]In another mode especially this invention is the method of reducing paper curl of the regular paper print elements which consist of a process of usually giving an ink composition to a base paper A method containing at least one curl inhibitor of sufficient quantity for the above-mentioned ink composition to remove substantially paper curl of an aqueous carrier medium colorant and the above-mentioned base material is included.

[0015]Besides the advantage of removing curl it was found out by the surprising thing that the ink of this invention is useful for a still more specific use. For example it became clear that "paddling" can be controlled by the ink of a certain kind using the curl inhibitor written in this specification so that it might explain in more detail below. "Paddling" shows that ink spreads on a cover plate from a pen nozzle and this has a possibility of producing a defect at the time of a print. Thereby although it was also found out that the color system ink of this invention causes increase of chroma saturation and a color gamut the range of dye concentration became large it faced prescribing ink and its flexibility increased further rather than the former was possible (refer to U.S. Pat. No. 5118350).

[0016]The person skilled in the art recognizes that many compounds enumerated above are the publicly known additive agents for the ink jet ink for other purposes. For example U.S. Pat. No. 5100469 teaches that the drying rate of print ink jet ink may be improved by adding 0.1 thru/or about 8% of the weight of a ****-erythritol a TORIMECHI roll alkyl compound TORIMECHI roll alkylamine or its salt. Similarly JP2-14262A and JP2-14260A teach the quick-drying color system ink jet ink which has 0.5 to 25% of the weight of trimethylolpropanediol or trimethylolpropanediol respectively combining 1.0 to 10% of the weight of lower alcohol.

[0017]A majority of such compounds are publicly known moisturizers. However generally these compounds have been used by too low concentration for obtaining the curl prevention profits taught to this specification. Nevertheless when these compounds were used by sufficient concentration to produce a curl prevention operation it was found out that it is a still effective

moisturizer.

[0018]

[A detailed description of an invention] The water-based ink of this invention is suitable for an ink jet printer and especially using it for a heat ink jet printer generally especially. This ink composition includes both paints and color system ink. Ink suits the requirements for a specific ink jet printer and provides the sufficiently publicly known light stability which was able to take balanced dirt tolerance viscosity surface tension optical density low toxicity high substance compatibility and a drying rate in this industry.

[0019] An aqueous carrier medium aqueous carrier medium is a mixture of water or water and at least one water soluble organic solvent other than a curl inhibitor. Generally deionized water is used. A water soluble organic solvent is publicly known enough and the example of representation is indicated by U.S. Pat. No. 5085698 (this specification is joined by reference in the description content). Selection of the suitable mixture of water and a water soluble organic solvent is based on the drying time of desirable surface tension and viscosity selected colorant and ink and the requirements for the medium base material with which ink is printed. The mixture of the water soluble organic solvent (for example diethylene glycol) and deionized water which have at least two hydroxyl groups is preferred as an aqueous carrier medium.

[0020] When using the mixture of water and an organic solvent as an aqueous carrier medium water contains 60 % of the weight - 95% of the weight of an aqueous carrier medium preferably 30 % of the weight - 95% of the weight on the basis of the gross weight of an aqueous carrier medium including the weight of the curl inhibitor. The quantity (the weight of a curl inhibitor is included) of an aqueous carrier medium When choosing an organic color choosing an inorganic pigment about 84 to 99.8% preferably about 70 to 99.8% on the basis of the gross weight of ink and choosing about 70 to 99.8% and a color preferably about 25 to 99.8% it is 80 to 99.8% of range.

[0021] In colorant this invention useful colorant is a pigment dispersion object and

a color. The term of "paints" means the colorant used in the insoluble granular state. The term of a "color" means the colorant used in the state of fusibility. The term of a "pigment dispersion object" shows the mixture of paints and a dispersing agent so that it may be publicly known in this industry and as it is used into this specification. Preferably a dispersing agent is a polymers dispersing agent.

[0022]Color: As a useful color negative ion nature positive ion nature both sexes and a nonionic color are mentioned to this invention. Such a color is publicly known enough to a person skilled in the art. A negative ion nature color is a color which produces coloring negative ion in an aqueous solution and a positive ion nature color produces a coloring positive ion in an aqueous solution. Generally a negative ion nature color contains carboxylic acid or a sulfonic group as an ion portion. A positive ion nature color usually contains a quaternary nitrogen group. Both sexes colors are negative ion nature and positive ion nature or have both electric charges as a function of solution pH. A certain kind of nonionic color has sufficient water solubility to use for a water-based ink. The color which has solubility insufficient in an aqueous carrier medium is processed as paints and it may be distributed in order to use for a water-based ink by the same method as the following.

[0023]Generally the color of the above-mentioned complete range is classified according to the end use. Some of colors of the more useful kind of this invention are edible distribution mordanting a bath solvent and reactive dye acidity basicity and directly. These kinds of all colors One or the peculiar functional group beyond it For example a nitroso compound a nitro compound an azo compound a stilbene compound a diaryl ether compound -- a methyl methane compound a xanthene compound a quinoline compound and a thiazole compound. An azine compound an oxazine compound a thiazine compound an amino ketone compound It has an anthraquinone compound an indigoid compound and a phthalocyanine compound a diphenylmethane compound an acridine compound a quinoline compound methine or a poly methine compound an indamine or the India phenyl compound and these are

all publicly known enough to a person skilled in the art. The color and quantity of a color which are used for an ink composition are one function of selection dramatically and are based on the purity of the desirable color of the print attained mainly using ink and a color and its concentration. Sufficient vividness does not arise with a color being low concentration. The dark color which its high concentration cannot be [print head performance] insufficient or it cannot permit is produced. 0.05 to 8 % of the weight of colors exist in 0.1 to 5% of the weight of quantity still more preferably preferably 0.01 to 20% of the weight on the basis of the gross weight of ink.

[0024] Paints: Paints useful to distribution are independent or combine and contain wide range organicity and inorganic pigment. An insoluble color may also be indicated substantially [medium / aqueous carrier] here. Paints particles need to be small enough for making into easy flow the ink in the projection nozzle which passes an ink jet printing device and which usually has a diameter of the range of 10-50 microns especially. Particle diameter affects the stability of a pigment dispersion object further. The Brownian motion of a fine grain is useful to prevent sedimentation of particles. When particle diameter is small it is desirable also for maximum color concentration. The ranges of useful particle diameter are about 0.005 micron - 15 microns. The particle diameter of paints is 0.005-5 microns and is 0.01-0.5 micron most preferably.

[0025] The selected paints can be used with desiccation or a humid gestalt. For example paints are usually manufactured in an aqueous medium and the paints produced as a result are obtained as a water wettability filter press cake. In a filter press cake gestalt paints are not condensed to a grade like [in the case of being a dry gestalt]. Therefore the paints of a water wettability filter press cake gestalt do not need equivalent solution condensation in the process of manufacturing ink from dry paints. The typical commercial desiccation and filter press cake paints which it faces carrying out this invention and can be used are indicated by above-mentioned U.S. Pat. No. 5085698.

[0026] This invention may be carried out using the microscopic particles of metal

or a metallic oxide. For example metal and a metallic oxide fit preparation of magnetic ink jet ink. The oxide of detailed particle diameter for examples silica alumina and titania etc. may be chosen. Detailed grinding metal particles for example copper iron steel aluminum and an alloy can be chosen for a suitable use. In the case of an organic color ink may contain pigments to about 30 % of the weight but generally 0.1 to 15% of the abbreviation of the weight of the total ink composition is about 0.1 to 8% preferably at most heat ink jet printing uses. Since ink tends to contain the pigments of high weight % compared with the ink which used the organic color and an inorganic pigment generally has specific gravity higher than an organic color when choosing an inorganic pigment it is height of about 75% in some cases.

[0027] Dispersing agent: A polymers dispersing agent is a desirable dispersing agent for paints. As a polymers dispersing agent suitable for operation of this invention ABBAB or ABC block copolymer is mentioned. Since a polymers kind with the tendency which plugs up a pen nozzle is not included the polymers dispersing agent manufactured by the basis transfer polymerizing method is the most preferred. Suitable AB or BAB block copolymer and its composition are indicated by above-mentioned U.S. Pat. No. 5085698. Suitable ABC triblock copolymer and those composition are indicated by Ma et al. and USSN 07/838181 (February 201992 application) (this specification is joined by reference in the description content). Although a random copolymer can be used as a dispersing agent they are not effective in stabilizing a pigment dispersion object like block polymer therefore preferred.

[0028] Generally as for a polymers dispersing agent 0.1 to 30 % of the weight of abbreviation of the total ink composition exists preferably in about 0.1 to 8% of the weight of the range. The dispersion stability of paints particles will be damaged if a polymers dispersing agent exists insufficiently. everything but a desirable polymers dispersing agent compound -- or a detergent compound may be instead used as a dispersing agent. As these examples negative ion nature positive ion nature nonionic or an ampholytic surface active agent is

mentioned. Non-polymers and the detailed table of some polymers dispersing agents McCutcheon's Functional. Materials and North American. It is shown in Edition 1990 Manufacturing Confection Publishing Co. Glen Rock NJ and the paragraph (110-128 pages) about the dispersing agent of 07452 (the description content by reference.). This specification is joined.

[0029] A curl inhibitor suitable for using for curl inhibitor this invention contains the polyhydroxy basis and/or polyoxyalkylene group which are obtained by the reaction of a polyhydroxy basis and alkylene oxide. This compound has at least 4.5% of water solubility (they are 4.5 copies of curl inhibitors in 100 copies of water) and is represented with 25 ** by the compound of the kind indicated below.

[0030] (a) Those polyoxyalkylene derivatives that have 1,3-diol, 1,3,5-triolamino-1,3-diol or the above-mentioned structural formula constitute the curl inhibitor of the first kind suitable for using for this invention. As an example of the curl inhibitor contained in this kind: 2,2-dimethyl-1,3-propanediol, 2-methyl-2-ethyl-1,3-propanediol, 2,2-diethyl-1,3-propanediol, 2-methyl-2-propyl-1,3-propanediol, 2,4-butanetriol, 3-methyl-1,3-pentanetriol, 1,3,5-pentanetriol, 2,4-pentanediol, 1,1,1-tris(hydroxymethyl)aminomethane, 2,2-bis(hydroxymethyl)-2,2'-and 2,2''-nitritoltriethanol, 2-amino-2-methyl-1,3-propanediol and 2-amino-2-ethyl-1,3-propanediol are mentioned. Mineral acid like chloride may neutralize an amino compound all or in part. A polyoxyalkylene compound is derived from the compound of the above-mentioned list.

[0031] (b) Another curl inhibitor of a kind suitable for using for this invention comprises the oxyalkylene derivative which has polyol and the above-mentioned structural formula. The term of "polyol" as used in this kind means the compound which has 3-8 hydroxyl groups which combine a hydroxyl group or a hydroxymethyl group with a main chain. The term of an "oxyalkylene derivative" means one which replaces hydrogen on a hydroxyl group or the oxyalkylene repeating unit beyond it. As some examples of this kind of polyhydroxy compound: 2-hydroxymethyl-1,3-propanediol, 2-ethyl-2-(hydroxymethyl)-1,3-propanediol, 2-methyl-2-(hydroxymethyl)-1,3-propanediol, TORIMECHI roll

butane-2,3,4,5-tetraol-erythritol-D- and DL-threitol-D- and L-arabitol-xylitol-dulcitol-L-iditol-D-mannitol-D-sorbitol and racemic sorbitol are mentioned.

[0032] A polyoxyalkylene derivative is derived from the polyhydroxy compound from the above-mentioned group. It was not found out that unreacted glycerol is an effective curl inhibitor and the unreacted pentaerythritol does not have sufficient water solubility. However, it has become clear that glycerol and the polyoxyalkylene derivative of a pentaerythritol are useful curl inhibitors. Other useful triol for oxy alkylation is trimethylolpropanetri-methylethane and 1,2,6-hexanetriol. As an example of some marketing of polyol / alkylene oxide condensate Liponic^(R) EG-1 Liponic^(R) SO-20 (Lipo Chemicals Co. Paterson NJ)-hotonol^(R) PHO-7149 Photonol PHO-7155 (Henkel.) Corporation; Ambler PA); Voranol^(R) 230-660 and Voranol^(R) 234-630 (Dow Chemical Co.; Midland MI); Fomrez^(R) T-279 Fomrez^(R) T-315 Fomrez^(R) ET-190. And Fomrez^(R) ET-250 (Witco Corporation Organics Division; New York NY) is mentioned.

[0033] (c) An aldoseketosealdonic acid soluble metal aldonic acid salt and its polyalkoxy alkylene derivative constitute the curl inhibitor of a kind (c). As an example of these compounds the erythrose of D- and L-moldal threose The corresponding aldonic acid of arabinose arabinoselixosexyloseglucosemannosealtroseallosegalactoseidosegrowth and the above is mentioned. The latter examples are D-gluconic acidD-mannonic acidD-altronic acid and D-Aaron acid. The example of a soluble metal aldonic acid salt is potassium gluconate.

[0034] (d) Pyranosides and those polyalkoxy alkylene derivatives constitute the next kind for using for this invention of curl inhibitor. As the example methyl alpha D-glucoside and methyl beta D-AROSHIDO is mentioned. As a polyoxyalkylene derivative available Glucam R products are mentioned from Amerchol and Edison NJ.

[0035] (e) The curl inhibitor contained in a kind (e) is a poly (alkoxy ethylene)

compound which has the above-mentioned structural formula. As this kind of a typical compound triethylene glycol, tetraethylene glycol, pentaethylene glycol, hexaethylene glycol, octaethylene glycol, the polyethylene glycol 200, the polyethylene glycol 400 and polyethylene glycol 1000 grade are mentioned. A diethylene glycol is not an effective curl inhibitor. The compound of a higher molecular weight may give superfluous viscosity to ink, may cause condensation of a pigment dispersion object and is an almost ineffective curl inhibitor. Therefore such a compound is not preferred.

[0036] (f) The curl inhibitor of the last kind contains polyoxyalkylene derivatives such as the polyoxyalkylene derivative of aliphatic polyamine, for example ethylenediamine, diethylenetriamine and TORIECHI rente truck amine. As an example of marketing of the polyalkylene derivative of TORIECHI rente truck amine it is Fomrez R K-22-66 (Witco Corporation Organics Division; New York NY). An amine group may be neutralized all or in part by mineral acid, for example chloride.

[0037] The mixture of the compound contained in within the limits of the above-mentioned kind and it is also useful to this invention. Especially the mixture of the compound which exists from the kind (a) or (b) and the compound which exists from a kind (e) is preferred and 10 to 90% of one of the compounds selected in this case exists in 25 to 75% of quantity preferably on the basis of the gross weight of a curl prevention mixture. Kind (a) Although the polyoxyalkylene derivative of the compound of - (f) is prepared from ethylene propylene oxide or the combination of both oxides, the mixture of ethylene oxide or ethylene oxide and propylene oxide is preferred. The reaction with single alkylene oxide may produce the mixture of the compound which has oxy alkylation of various grades on each hydroxyl group. Therefore the above-mentioned structural formula is based on the average composition thing containing the oxyalkylene unit of a certain range. It may be random in propylene and ethylene oxide and a block copolymer chain may be used. For example a polyhydroxy compound is made to react to propylene oxide first and subsequently it is made to end by ethylene oxide

one by one.

[0038] In many cases various hydroxyl groups or those alkoxide salts are in a nonequivalence position. Therefore they can react to alkylene oxide at a different rate by a steric factor and nucleophilicity. Therefore various hydroxyl groups in the same compound may have a different polymerization grade. When removing paper curl substantially in order to be effective the curl inhibitor must exist in at least 10% of the weight of quantity on the basis of the gross weight of an ink composition. The permissible range of a curl inhibitor is 15 to 30% most preferably 12 to 55% 10 to 75% on the basis of the gross weight of ink.

[0039] Other ingredient this ink may contain other ingredients. For example surface tension is changed using the above-mentioned surface-active agent and osmosis can be made into the minimum. However since the surface-active agent can make a pigment dispersion object unstable it needs to be careful of it to secure the compatibility of a surface-active agent and other ink components. In a water-based ink 0.01 to 5% of a surface-active agent exists in 0.2 to 3% of quantity preferably on the basis of the gross weight of ink. In order to prevent growth of a microorganism a biocide can be used into an ink composition. As an example of such a biocide Dowicides^(R) (Dow Chemical Midland MI) Nuosept^(R) (Huls America Inc. Piscataway NJ) Omidines R (Olin Corp. Cheshire CT) Nopcocides^(R) (Henkel Corp. Ambler PA) and Troysans^(R) (Troy Chemical Corp. Newark NJ) and sodium benzoate are mentioned.

[0040] In order to remove the adverse action of heavy metal impurities a sequestering agent like EDTA may be made to contain. The acrylic or other publicly known additive agents for example a viscosity controlling agent and others or non-acrylic polymer may be added and the various characteristics of an ink composition may be improved. As mentioned above many curl inhibitors of this invention are effective moisturizers for many ink-jet-ink formula things.

[0041] The ink composition of ink preparation this invention is prepared by the same method as other ink jet compositions. When using a pigment dispersion object as colorant a dispersing element carries out preliminary mixing and

prepares the underwater selected paints and dispersing agent. A dispersing process as indicated to U.S. Pat. No. 5026427 in level minimilla ball mill and ATORITTA Or it lets a mixture pass with the fluid pressure of at least 1000 psi for two or more nozzles of the liquid jet interaction interior of a room and can attain by producing homogeneous distribution of the paints particles in an aqueous carrier medium. Other auxiliary solvents which can improve osmosis or the DEKYAPPU (decap) characteristic may be made to exist in a dispersing process.

[0042] When using a color as colorant a dispersing agent does not exist but there is no necessity for paints solution condensation. Color system ink is prepared with the container enough stirred rather than the dispersion device. Generally it is desirable to make the ink jet ink of a concentration gestalt and this is taken as suitable concentration to dilute with a fluid suitable after that and use by an ink-jet-ink print system. Dilution adjusts ink to desirable viscosity a color hue chroma saturation concentration and print region covering to a specific use.

[0043] Ink-characteristics jet speed the separation length of a glob dropping size and flow stability are dramatically influenced by the surface tension and viscosity of ink. ink jet ink suitable for using it by an ink jet printing system -- 20 ** -- about 18 dyne/cm - it is necessary to have the surface tension of the range of 20 dyne/cm - about 50 dyne/cm still more preferably about 70 dyne/cm 20 or less cp of viscosity which can be permitted are the ranges of about 1.0 cp - about 10.0 cp preferably at 20 ** by the suitable rheology about image setting and heat ink jet combustion supplement frequency.

[0044] Ink has the shape and the size of the drive frequency of the pressure element for the driver voltage for the physical characteristic which can suit wide range projection conditions i.e. a heat ink jet printing device and pulse width a drops device on demand or an interlocking device and a nozzle. They suit using it with continuation piezo-electric drops on demand and heater various ink jet printers like bubble jet drops on demand and using it especially with a heat ink jet printer. Ink has the outstanding prolonged preservation stability and is not got blocked in an ink jet device. The ink of this invention is useful especially although it uses

when printing a regular paper element but it is suitable also for using for various print media for example textiles a transparent thing etc. The printed ink image has a clear color tone and is high-density. Ink is the component parts and compatibility of an ink jet printing device and they are no odor intrinsically.

[0045] As mentioned above it was found out that the ink composition of this invention provides a surprising thing with an additional advantage. For example the ink set containing the cyanogen the magenta and the yellow dye system ink composition of this invention usually produces a remarkable improvement of a paper color region as compared with the color system ink which has the same dye concentration and does not contain a curl inhibitor. This color-gamut increase makes primary and secondary color clearer and lessens the deviation of the whole paper. If the dye concentration in such ink is adjusted a color gamut can be improved further and a more nearly symmetrical color space is obtained. The ink jet ink set which has the above-mentioned special feature The magenta ink containing the cyan ink containing 1.75 to 2.5% of acid blue 9 color the yellow ink containing 1.75 to 3% of acid yellow 231 to 3% of reactive red 180 and 0.3 to 1.5% of acid red 52 is included.

[0046] Another wonderful advantages of the ink of this invention are those improvement paddling characteristics. It is publicly known from USSN 07 / 845332 (April 28 1992 application) (the disclosure is included in this specification with a reference) to add anionic polymer in negative ion nature color content ink and to provide improvement of the paddling characteristic. It was found out that the same improvement in paddling is obtained using the ink of this invention which has significant more low polymer concentration (for example comparing with polymer about 1.0% about 0.25% polymer). If polymer concentration is reduced decap performance will become good and generation pliability will become larger and cost will be reduced.

[0047]

[Example] The following examples explain this invention further. Unless it writes weight shows a part and especially percent. All the ingredients used into

the ink formula thing came to hand from Aldrich Chemical Milwaukee and WI unless it mentioned specially.

[0048] Operation A: Butyl methacrylate// methacrylic acid (BMA//MAA=10//10) AB block polymer (molecular weight 2400)

It is a mechanical agitation machine a thermometer and N₂ to 12 liter flasks. It is equipped with the entrance the drying tube exit and the addition funnel. 3750 g of tetrahydrofurans ("THF") and 7.4 g of p-xylene were put into the flask. Next the tetrabutylammonium m-chlorobenzoate catalyst (3.0 ml of 1.0M solutions which dissolved in acetonitrile) was added. 291.1 g (1.25M) of initiator 11-bis(trimethylsiloxy)-2-methylpropenes were poured in. The feeding I [3.0 ml of 1.0M solutions which dissolved in a tetrabutylammonium m-chlorobenzoate and acetonitrile] was started in 0 minute and it added for 150 minutes. The feeding II [1976 g (12.5M) of trimethylsilyl methacrylate] was started in 0 minute and it added for 35 minutes. It completed after the feeding II in 180 minutes (not less than 99% of monomers reacted). The feeding III [1772 g (12.5M) of butyl methacrylate] was started and it added for 30 minutes. [0049] As of 400 minutes the dry methanol 780 g was added in the above-mentioned solution and distillation was started. The 1300.0 g substance which has the boiling point below 55 °C all over the first step of distillation was removed from the flask. The amount of theories of the methoxy trimethylsilane (boiling point = 54 °C) removed was 1144.0 g. Although distillation was continued among the secondary stage the boiling point went up at 76 °C in the meantime. 5100 g of i-propanol was added during distillation of a secondary stage. 8007 g of solvents removed all. By this operation AB block polymer solution of 52.5% BMA//MMA which dissolved in THF and i-propanol was produced and the paints concentrate was prepared as follows using this. It neutralized by 45.6% KOH 3.86 g which mixed the above-mentioned solution 19.05 g with 77.1 g of deionized water and the polymer solution was made 10%. This solution was used for Examples 13, 18, 27 and 28.

[0050] Operation B: butyl methacrylate// butyl methacrylate -- methacrylic acid (BMA//BMA//MAA=10//5//10) AB block polymer (molecular weight 3100)

Three liter flasks were equipped with a mechanical agitation machine, the thermometer, N₂ entrance, the drying tube exit, and the addition funnel. 780g of tetrahydrofurans (THF) and 3.6 g of p-xylene were put into the flask. Next catalyst tetrabutylammonium m2ml was added. 72.0 g (0.62M) of initiator 11-bis(trimethylsiloxy)-2-methylpropenes were poured in. The feeding I [3.2 ml of 1.0M solutions which dissolved in a tetrabutylammonium m-chlorobenzoate and acetonitrile] was started and it added for 130 minutes. The feeding II [n-butyl methacrylate 220g (1.55M) and 490g (3.1M) of trimethylsilyl methacrylate] was started in 0.0 minute and it added for 40 minutes. 30 minutes after the feeding II was completed the feeding (not less than 99% of monomers reacted) [440g (3.1M) of n-butyl methacrylate] III was started and it added for 30 minutes.

[0051] As of 240 minutes the dry methanol 216g was added in the above-mentioned solution and distillation was started. The substance 210.0g which has the boiling point below 55 °C all over the first step of distillation was removed from the flask. Although distillation was continued among the secondary stage the boiling point went up at 76 °C in the meantime. Distillation was continued until it added 900 g of i-propanol and all were removed during distillation of a secondary stage as for 1438g of solvents. Thereby BMA/BMA/MAA=10/5 / 10 polymer arose by the solid 57.7%. It neutralized by 45.6% KOH 4.63g which mixed the above-mentioned solution 17.33g with 78.0 g of deionized water and the polymer stock solution was made 10%. This solution was used for Example 17.

[0052] Examples 1-25 -- in the example of these it mixed together and all color system ink prepared all the ink components or the aqueous stock solution of those until the homogeneous solution was obtained. It added stirring the water of an initial complement in this solution and the whole quantity of ink was 100 g. The color came to hand from the commercial maker. Refining colors were used. All paints system ink (examples 19-23) 46.1 g of diethylene glycol. It prepared from the distributed concentrate containing 632 g of deionized water 150g of FW18 carbon black pigments (DeGussa Corp. Allendale NJ) and the 52.5% polymer solution 142.9g from the operation A and neutralized by KOH 29.0g 45.6%.

[0053]The size of the resistor put into the heat ink jet pen which has a 30-40-micron orifice at 42-50 micronsand examined ink. In order to reduce the length of time required to dry a printthe pen was finished into the ink jet printer which uses heat. The mechanical curl reduction device was not used. In order to simulate a bad exampleall the pages of the double density blackout (double density blackout) which has a 1/4-inch margin were printed using various regular papers (shown below). The print face was turned upthe printed paper was placed on the flat surfaceand the curl amount was become final and conclusive by measuring the distance between the edge of paperand a flat surface at intervals of 1 hour24 hours48 hours72 hoursand 96 hours. The quantity which curl can permit was defined as being less than 40 mm based on aestheticsreadabilityand the ease of handling.

[0054]Example 1-contrast diethylene-glycol monobutyl ether 8.0g acid blue 9 and CAS#3844-45-9 2.2g biocide 0.3g deionized water 89.5g [0055]Example 2

diethylene-glycol monobutyl ether 8.0g2-ethyl-2-(hydroxymethyl)-13-propanediol 15.0g acid blue 9 2.2g biocide 0.3g deionized water 74.5g [0056]Example 3-contrast diethylene glycol 10.0g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 (Union Carbide Corp) 0.2g acid blue 9 2.2g deionized water 83.6g

[0057]Example 4-contrast 33-dimethyl- 12-butanediol 10.0g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-770.2g acid blue 9 2.2g deionized water 83.6g

[0058]Example 52-ethyl-2-hydroxymethyl-13-propanediol 10.0g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9 2.2g deionized water 83.6g

[0059]Example 6 triethylene glycol 10.0g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9 2.2g deionized water 83.6g [0060]Example 7

tetraethylene glycol 10.0g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9 2.2g deionized water 83.6g [0061]Example Eight polyethylene-

glycols MW400 10.0g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9 2.2g deionized water 83.6g [0062]Example 9 sorbitol 10.0g

diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9 2.2g deionized water 83.6g [0063]Example 10 tris(hydroxymethyl) aminomethane

10.0g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9 2.2g
 deionized water 83.6g [0064]Example 11 neopentyl glycol 7.5g tetraethylene
 glycol 7.5g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9
 2.2g deionized water 78.6g [0065]Example 122-methyl-2-(hydroxymethyl)-13-
 propanediol 7.5g tetraethylene glycol 7.5g diethylene-glycol monobutyl ether
 4.0gSilwet^(R) L-77 The 0.2g acid blue 9. 2.2g deionized water 78.6g
 [0066]Example 132-methyl-2-propyl-13-propanediol 7.5g tetraethylene glycol
 7.5g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77 0.2g acid blue 9 2.2g
 deionized water 78.6g [0067]Example 1422-diethyl- 13-propanediol 7.5g
 tetraethylene glycol 7.5g diethylene-glycol monobutyl ether 4.0gSilwet^(R) L-77
 0.2g acid blue 9 2.2g deionized water 78.6g [0068]Example 152-ethyl-2-
 (hydroxymethyl)-13-propanediol 7.5g tetraethylene glycol 7.5g diethylene-glycol
 monobutyl ether The 4.0gSilwet^(R) L-770.2g acid blue 9. 2.2g deionized water
 78.6g [0069]Example 162-ethyl-2-(hydroxymethyl)-13-propanediol 18.0g
 dipropylene glycol 2.0gSilwet^(R) L-7607 Block polymer from the 0.5g operation A
 The 2.5g acid blue 9. 2.2g biocide 0.3g deionized water 74.5g [0070]Example
173-methyl- 1 and 3 and 5-pentanetriol (Fluka Chemical) 16.0gSilwet^(R) L-7607
 Block polymer from the 0.8g operation B 4.0g acid blue 9 2.2g biocide 0.3g
 deionized water 76.7g[0071]example 182-ethyl-2-hydroxymethyl-13-propanediol
 The 4.0g3-methyl- 1 and 3 and 5-pentanetriol 12.0gSilwet^(R) L-7607 Block
 polymer from the 0.8g operation A . 4.0g acid blue 9 2.2g biocide 0.3g deionized
 water 76.7g [0072]Example 19-contrast diethylene glycol 26.7g of 18.7g pigment
 dispersion object concentrates deionized water 55.8g [0073]Example 202-ethyl-
 2-(hydroxymethyl)-13-propanediol 17.5g pigment dispersion object concentrate
 26.7g deionized water 55.8g example 21 alpha D-glucose 26.7g of 17.5g
 pigment dispersion object concentrates deionized water 55.8g [0074]Example 22
 methyl-alpha D-glucoside 26.7g of 17.5g pigment dispersion object concentrates
 deionized water 55.8g example 23 D-gluconic acid Potassium salt 17.5g pigment
 dispersion object concentrate 26.7g deionized water 55.8g [0075]Example 24
 tris(hydroxymethyl) aminomethane 20.0gSilwet^(R) L-7607 1.0g acid blue 9 2.2g

biocide 0.3g deionized water 76.5g [0076]Example 25 tris(hydroxymethyl) aminomethane HCl 12.0g tris(hydroxymethyl) aminomethane The 3.0gAerosol^{R} OT (Fisher Scientific) 0.3g acid blue 9. 2.2g biocide 0.3g deionized water 82.2g [0077]
[Table 1]

[0078]
[Table 2]

[0079]Example The cyanogen which has a constituent of 26 followingmagentaand yellow ink were prepared.
cyanogen diethylene-glycol monobutyl ether . 7.0gSilwet^{R} L-7607. 1.0g acid blue 9 2.25g biocide . 0.3g deionized water . 89.45g magenta diethylene-glycol monobutyl ether 7.0gSilwet^{R} L-7607 1.0g acid red 52CAS#3520-42-1 The 0.6g reactive red 180CAS#85586-40-92.75g biocide 0.3g deionized water 88.35g yellow diethylene-glycol monobutyl ether 7.0gSilwet^{R} L-7607. 1.0g acid yellow 23 and CAS#1934-21-0 2.5g biocide 0.3g deionized water 89.2g [0080]Ink was printed on the regular paper indicated to Table 2 by the same method as Examples 1-25. Curl is measured like the above about cyan inkand it reports to Table 2. Color space data was obtained by Hunterlab PICCS 4800 (Hunter Associate LabsInc.RestonVA) using the light source and 2 observation device. A result is shown in the following table 3.

[0081]Example The same operation as Example 26 was performed using the cyanogen which has a constituent of 27 followingmagentaand yellow ink.
Cyanogen 2-ethyl-2-(hydroxymethyl)-13-propanediol 18.0g dipropylene glycol 2.0gSilwet^{R} L-7607 Block polymer from the 0.5g operation A The 2.5g acid blue 9. 2.25g biocide 0.3g deionized water . 74.45g magenta 2-ethyl-2-(hydroxymethyl)-13-propanediol 18.0g dipropylene glycol 2.0gSilwet^{R} L-7607

Block polymer from the 0.5g operation A The 2.5g acid red 52. 0.6g reactive red 180 2.75g biocide . 0.3g deionized water 73.35g yellow 2-ethyl-2-(hydroxymethyl)-13-propanediol 18.0g dipropylene glycol 2.0gSilwet^(R) L-7607 Block polymer from the 0.5g operation A . 2.5g acid yellow 23 2.5g biocide 0.3g deionized water 74.2g [0082]Example The same operation as Example 26 was performed using the cyanogen which has a constituent of 28 followingmagentaand yellow ink.

Cyanogen 2-ethyl-2-(hydroxymethyl)-13-propanediol 18.0g dipropylene glycol 2.0gSilwet^(R) L-7607 Block polymer from the 0.5g operation A The 2.5g acid blue 9. 2.0g biocide 74.7g of 0.3g deionized water magenta 2-ethyl-2-(hydroxymethyl)-13-propanediol 18.0g dipropylene glycol 2.0gSilwet^(R) L-7607 Block polymer from the 0.5g operation A . 2.5g acid red 52 1.0g reactive red 180 1.6g biocide 0.3g deionized water 74.1g yellow 2-ethyl-2-(hydroxymethyl)-13-propanediol 18.0g dipropylene glycol . 2.0gSilwet^(R) L-7607 Block polymer from the 0.5g operation A 2.5g acid yellow 23 2.75g biocide 0.3g deionized water 73.95g [0083]
[Table 3]

[0084]
[Table 4]

[0085]
[Table 5]

[0086]
[Table 6]

[0087] Although the ink of Example 27 had the same dye concentration as the ink of Example 26 the ink of Example 27 contained the curl inhibitor. Data explains the improvement (26%) with a usually significant paper color region by curl inhibitor addition. Although Example 28 was the same as Example 27 except dye concentration it showed improvement (increase of 5%) of a color gamut and improvement (increase of 18%) of blue chroma saturation.